

History of Zaca Lake
Mr. Robert Gray, SBCC
October 25, 1980

I will be describing a little bit about the concern of the way that the lake was formed. The lake represents a case where the natural forces that effected this area you can go back to the rock that you see in this illustration, the dippy white units around here that look like dexocard standing on end instead of sedimentary rock. These rocks are folded and you can see the folds that are shown behind the building here at Zaca Lake and of course part of this is that the river flowed along where there were breaks in the rock and of course there was weakness, so you have a river system that meandered down through here in a very steep canyon making very steep surfaces. However with these rocks these very dippy, very high repose on the rocks, gravity takes over and a lot of rocks that are hanging high in the air through geological times will begin to slide and we call it gravitational gliding, or landsliding, so the features move more rapidly than others. But slumping is very common to all rocks around Santa Barbara particularly this formation, the Monterey which is highly fractured. It is a unit which has a lot of variability in the rock and the wrinkles are usually very distorted, folded and up on end. When you get rocks like this up on end they tend to move down. There are actually two slides even more involved in this area. The major slide you see is where you drove in this morning. That slide appears to have moved across the river but Zaca Lake is associated with another slide but this may be younger than the one that actually damned the lake. The concerns about the formation

of Zaca Lake as a natural lake come about probably by the fact that you have high steep dipping through geological times that have such high angles of repose that some of it began to slip. In the process of damming this area you get a different ^{gradient?} radium, almost a horizontal radiant and like any dam that is natural, or in this case, man made, you will get sediment brought into this which is going to flow into it like a delta, but the lake will be forming here and you get a new radiance in the camp ground area that is fairly flat along here because the radiance has raised and we have a new base level and this base level of this area is almost flat. When you get past the landslide surface then you get incises back into the river system. That is probably the actual story of Zaca. The dates on the formation of the lake vary from 80,000 to 7,000 years ago but my feelings are that this is a feature that would not stay around 80,000 years. It is much younger than that. So this feature probably did exist up into early man times around here. It is relatively different here than it was 3,000 years ago. There is enough data about the lake and in the lake area to tell how far the lake sediments exist. I have a feeling that they exist fairly thick in here. As soon as you get a dam you are going to fill it up with sediment rapidly and the sediments will change from time to time. As far as the water is concerned I don't know about its history. The question of springs has been brought up but the only question with that is that there is no varification of the springs. It certainly is a lake and there is no different~~ization~~ in the water itself that suggests there is sulphur springs here. Another thing about the

rock as you go up the creek area is that you come across a series of traverteen type deposits because they are algae oriented form of green algae which is found in these areas and that suggests to me that the calcarius material is coming from the rock but the rock back up by the springs, if you break them open have a high sulphur smell to them. They are organic oil shale and they do have within them organisms that contain oil and sulphur material in the rock. So the rock itself being fractured could produce some sulphur. So really the geology is very young in age and the damming effect by these dippy beds which have past their angle or repose and have slid and all we know about this is if you live in Santa Barbara County you can't get away from its landslides.

History of Zaca Lake
Speaker, Sally Petersen
October 25, 1980

Zaca Lake is interesting for many reasons. One is that it is one of the few lakes in all of Southern California and such provides a unique opportunity to reconstruct past environmental conditions based on lake sediment. Zaca Lake is the only natural lake in Santa Barbara County. In Southern California there is one other natural lake, Crystal Lake in the Angeles National Forest in Los Angeles County. Zaca Lake is also interesting because of its somewhat unique lake condition when the lake undergoes the seasonal bloom of the purple sulphur bacteria, *Thiopodia Rosea*, and it changes the color of the lake from a milky gray to purple. Although I am far from being an expert I'd like to outline what we do know about the monology of the lake and discuss how these conditions may have been somewhat different in the past. Before I do this, I would like to set the scene with a little bit of the physical geology of the basin, much of this has been covered by the previous talk so I will go through it quickly. Zaca Lake has a shore line of 990 meters and an area of 6.9 hectors or about 17 acres. Although Indian legend pictures the lake as some sort of bottomless lake, the lake does have a bottom. It's deepest part is about 14 meters or 42 feet and the average depth is about 6.9 meters. The lake drains a water shed of 55 hundred hectors, most of which is the steep chaparral slopes that you see outside here. As far as the source of water is concerned, Zaca Lake is fed by several mineral springs which issue from the canyons around us following heavy rainfall in the winter. The lake is also fed by

ground water percolation, by seepage from springs located along some of the faults. These are from faults not in the lake, but there is a possibility of some spring action right at the bottom of the lake, but not much is known about that. And it is also fed by direct rainfall in big storms when a certain amount of water will fall right into the water. Zaca Lake drains into a lower lake which is seasonally dry and that lower lake is where you are parking your cars today, to the north west of the lecture area. And then, there is Zaca Creek which runs 6 to 8 months a year and it is that creek that you crossed so many times as you came into the area today. With respect to ^{LIMNOLOGICAL} limnological(?) conditions, Zaca Lake exhibits a warm season stratification that is characteristic of small temperate lakes. As the sun rises higher each day and the air about the lake warms the surface water which is in contact with the atmosphere, the surface water warms faster than the deeper water creating a sharp zone of temperature change across which the water does not mix. This zone of rapid temperature change or thermoclyne separates the warm water surface which is called the Upper Limion^N from the colder surface called the Hypo Limion upon which it floats. (diagram). This is a generalized diagram of Zaca Lake in the summer time. Here we have the temperature along the bottom axis, the water depth along the left axis from 0 to the surface of the lake is 14 meters from 0 degrees freezing to 20 degrees centigrade. The Hypomemion which is the lower water layer, has a temperature of, say, 7 to 10 degrees. In the upper surface we have 20 degrees centigrade and then this sharp zone as you go down to between 6 to 8 meters and it rapidly

becomes much colder, and this is the Thermocline. Most of the primary productivity in Zaca Lake occurs in this upper warm water zone, the Upper Limion where sun light is abundant. Here mulified plants or phito plankton and various larger algae assimilate energy from the sun to turn carbon dioxide in the water into glucose as simple sugar. This conversion of light energy to chemical energy or photosynthesis forms the basis of the food chain in Zaca Lake, like fueling the production of the plant tissue upon which the fish population feeds. This process of photosynthesis produces oxygen which supplements the production of oxygen due to mixing at the surface to keep this upper zone well aerated and thus suitable for animal life. There is plenty of oxygen in the upper lake in the summer time. The lower or cold water in the lake is usually below the level at which sunlight penetrates for photosynthesis to occur. Since there is not very much light at the lower depths you don't have any plants and if you don't have plants you don't have much oxygen. The result is that the fish and bacteria present on the lower layer rapidly depletes what oxygen anorobic conditions in the lower level of the lake. In other words very little oxygen. This persists for from 10 to 11 months a year at the lake. As the weather cools in the fall the temperature at the lake begins to drop and the surface water which is in contact with the air above cools more rapidly than the lower level. The cooling upper water becomes dense than this water below and it begins to fall down over it, which starts a circulation in the lake. This sinking of the upper level water over the lower water marks the beginning of lake overturn. At

Zaca Lake, this holarmix or overturn in the winter is, generally between 7.5 and 9.5 degrees centigrade. Often, between late November and mid February. This diagram shows the progress. You get a circulation of waters in the winter. The winter overturn at Zaca Lake has several important consequences, first the mixing process increases the productivity of the lake by bring up the dissolved mineral nutrients from decomposition from the bottom sediment, in other words a lot of nutrients down, can come up. This process of upturn sometimes causes a rapid growth of blue-green algae in the lake, called algo-bloom in the lake. If Zaca Lake did not turn over in the winter, these nutrients could be lost from the food chain. The second major change of lake overturn concerned the oxygen content of the water. During the summer months as I mentioned Zaca Lake exhibits pronounced vertical stratification of oxygen with high levels up at the surface and low levels at the bottom. As the oxygen deficient hypo-limnetic water mixes with the surface water during the winter all this low oxygen water in the circulation mixes with this upper water and the result is that you get very low oxygen concentration up at the surface. The upwelling of hydrogen sulphide reduces substances that are down at the bottom. Also it depletes the oxygen concentration in the surface water because where the substances are brought up they are oxidized and that process requires oxygen. The combined results of the upwelling of these reduced substances and the mixing of this low level of oxygen with the more concentrated above is that you get very low oxygen concentration in the lake following overturn. The lake can be

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anoxic to within 1 meter of the surface, which means if you went down three or four feet from the top of the water there would be less than 1 percent concentration of oxygen. This condition creates severe stress to the fish population. The current population is dominated by Black Bullhead, Green Solefish, Blue Gill, and Mosquito Fish. All species that are tolerant of low concentration of oxygen. Never the less conditions at Zaca Lake during turnover find that these fish have been observed breaking the surface and gasping for air. The rapid decline in surface oxygen concentration and the resulting fish stress during holimixes is rivaled by an even more unique condition with the seasonal bloom of the purple sulphur bacteria, Theopedia-Rosea. This is redistributed from the hypo-limnion where it is during most of the year to the upper level during the holimixes. Because of the high concentration of hydrogen sulphide which it uses for its metabolism are also brought up during that period. As the purple bacteria blooms, the water in the lake changes from a milky gray to a magenta hue and the shore line areas of the lake reflect a deep pink. The sulphur bacteria which utilizes hydrogen sulphide in their metabolism remains in the upper layer at the lake for about a month until a new stratification or a return to the more mild temperature. Following the renewal of stratification, the Theopedia Rosea are found only in the hypolimnion where the rotting of fish and plants fall to the bottom of the lake. Historical records point to the fact that these conditions may not have occurred in the same manner every year. I've mentioned that the present fish population is dominated by species that are

relatively tolerant of low oxygen concentration but historical notes and fish stocking records suggest that severity of oxygen depletion following the over-turn of the lake has been less at times in the past. Large-Mouth Bass, a fish less tolerant of the oxygen conditions was thought to survive for several years only to be eliminated during over-turn in particular years. Mr. Libeau, a nephew of the early homesteader, John Libeau, states the "in the days when my family occupied the homestead, the lake proper was a kind of cranky thing. For years they had attempted to plant fish in it and occasionally the fish would prosper only to die after some years of what looked like an upboiling of the water. At that time when the lake which was normally clear, would become more opaque. However until 1927 the lake was filled with living Black Bass but I did hear that this upboiling again occurred and killed the fish." More recent California Fish and Game records indicate that the lake was planted with Large Mouth Bass in 1940 but by 1949 these fish had been eliminated. In studying the mineral and pollen content of the sediment of Zaca Lake, I have uncovered further information about past windological conditions in the lake. Diagram. From the core sample taken of the sediments in the lake you can see that I pulled up 3.7 meters of sediment until we come to some clay material that would not allow us to progress further. From this core there are three main sediment types in the core sample. Dark organic material, gray clay, which symbolizes the absence of color, and some fine line zones here. Two important requirements include carbon dioxide poor conditions at the surface and oxygen poor conditions at depths. These

conditions are not compatible with overturn of the lake which results as we saw both in oxygenation or increasing the oxygen in the lower layers of the lake as well as upwelling which would continually replace the carbon dioxide in the upper levels of the lake. For this reason the presents^{ce} of sections of the carbonization suggest that there have been periods in history of the lake when the lake did not over-turn. My thinking of this is that Zaca Lake has periodically functioned as a mirror-medic lake which can take the lower circulation of water mass that is isolated from the upper part of the lake. What I am suggesting is not that the lake did not over-turn at all but that the lake over-turned only at the upper reaches leaving the lower area^e anirobic or without oxygen through out the year. In summery, I would like to leave you with these few thoughts, the first is that limologically speaking Zaca Lake is very unique. It is one of the few lake in Southern California, and that it provides a unique opportunity to reconstruct environmental conditions based on the analysis of lake sediment. Second, Zaca Lake undergoes a decline in sufficient oxygen and results in fish stress during over-turn which is much greater than most temperate lakes. Third, Zaca Lake experiences an extensive bloom of purple sulphur bacteria, and this changes the lake color which is not seen very often. Fourth, Zaca Lake may have a history of lake variation in it's linological cycle such as the lake may not over-turn every year. Obviously Zaca Lake is important for other reasons. For example the food chain in the lake. The fish that eat the plankton are eaten by other fish, is surely an important source for prehistoric and

other people as an important food source. Thank you.

History of Zaca Lake
Dr. Steven Horn
Oct. 25, 1980

Steven Horn is Forest Service Archaeologist for Los Padres National Forest. He has done a great deal on the history of the Inland Chumash. Zaca Lake is a portion of that area of study.

Early Man...First, I would like to dispel the rumors spread by Bob Graham and Tom Dibblee about the origin of this lake having to do with land slides. The true story is that a group of Indians were having lunch at the lake when Thunder showed up. Thunder was a super-natural being of great power and feared by many people. One of the men was not impressed by Thunder, and spoke of him in a rude way. Thunder was not accustomed to this indignity. It made him mad. Everyone else knew what might happen and left the area except the man who had spoken to Thunder. As the people looked back up the canyon as they made a hasty retreat, they saw that all that was left of that rude man was a little carbonized pile of remains and a big hole where Thunder had sat, and that is how the lake got started. It is interesting to hear the stories of the supernatural about this lake, these can be traced back to what the Indian people told each other and then to John Peabody Harrington the primary linguist who studied these Chumash when he worked for the Smithsonian. Another story.... There was a little girl here at Zaca with her family gathering islay(Cherries). The little girl was misbehaving so that her mother could not go gathering so the mother left her daughter alone. The girl was beguiled by a spirit of the lake, a reflection of a woman, and followed the woman down into the lake. When the family came back they could not find the girl. One of the family said she had to be near

somewhere. The child was in the lake so they called for a strong man and went all the way to the Channel Islands to find one. He swam out to the middle of the lake and dived down 42 meters to the bottom where he found an Indian village. The swimmer went into the village, but the people ignored him. He sat there for four days, waiting. Finally one of the villagers asked, "What do you want here?" "I want the little girl." They gave her to him and they went back up to the surface bringing the girl back to her parents. So we know there was a village at the bottom of the lake.

Pre-history goes back to an unknown time for this area, some say the earliest people to enter the new world and particularly California came over the land mass 35,000 years ago. That is only a guess. One thing that probably happened was that peoples villages are under water now. In those ancient times sea level was lower because of the glaciers. This is probably why we can not see their villages or camps because of the melting of the Ice Age and the rising of the sea water. The earliest evidence of human occupation of inland south coast ranges is around Buena Vista Lake about 5,000BC. We don't have dates like that for this area but using common sense and an educated guess which are the main tools of an archaeologist anyway, you can guess that the people who lived at Buena Vista Lake (southern San Joaquin Valley) might have come in here. Buena Vista Lake is gone now, drained for agriculture. In those days it was probably bigger than in later years when the Spanish came. It was recorded by them. It

is not unlikely that groups of people similar to those living at Buena Vista went up into the hills around Cuyama Valley, Frazier Park, and Carriso Plains, perhaps as far as Sisquoc, Manzanita, and around here. They were probably traveling in small groups of ten, or less, 20 people would be a large group 5,000 years ago. They would be composed of a father, mother, children, and grandparents and a cousin or two. Kin-based groups relatively small and highly mobile, in other words they moved their group around pretty much following the ripening of the important food stuffs that they ate. And of course they followed the herds of deer and other animals. They went to the food source as a group. They did not have established villages as was seen later along the coast of Santa Barbara. Evidence has been found of small fires, chips of stone, and simple technology. Their projectile points tended to be large because the point was used at the end of a spear that was thrown that is called an Addle-^{ATLAL}Addle. This spear was thrown faster and farther and with good accuracy. That was their major tool as far as we now know. Their diet consisted of kinds of seeds that are from grass lands, hard seeds that are not particularly productive but they are there every year and are reliable. Reliability was important because when you have a really small group of people you can't risk too much. This pattern persisted we think, up to around 1,000BC. About this time we find actual use of what is now called Los Padres National Forest. In this earliest evidence we found big hearths that they used to roast Yucca, apparently this plant was very nutritious. About 500 BC we found an important change to an almost permanent village, not too big but we are

pretty sure that the villages were there all year round. One evidence of this is food storage capabilities. If you store food, you need to have someone there to guard that storage. Also about this time we found that the use of a different kind of plant food. Before the people relied on low production food but now it became the acorn and other things associated with trees and nuts. A very productive food source. With an expanding population you get a distribution of risk across the entire population that lived in the inland country. So that you had a village in Birabent Canyon, one on the Manzana Creek, and between the two, others to trade with. The distribution of risk is spread out among a greater group of people over a wider area. We can infer that this development took place because of the soft seed, a different kind of artifact is needed to grind it up. The hard seed is associated with a milling stone, the soft seed, with a mortar and pestle. This happened around the time of Christ. They also used a bottomless basket with the mortar to keep the seed from falling to the ground. The population was increasing and there was trading going on. Resources from the coast are now making their way to the inland. Shell beads that were probably made on Santa Cruz Island appeared in the inland territory. In Cuyama Valley were found water mussels that came from Buena Vista Lake. There was now a trade network appearing. We also found that some villages were specializing. One is in Oso Canyon where there happens to be a serpentine outcrop and there you can see where the ancient people made beads from this stone. On the ground you can see chips of stone, and partly made beads. This was a workshop. Some

fresh water

villages were specializing and trading for other goods. Things are not getting fairly complicated, a trade network, food storage, and a differentiation of social classes. The first bureaucrats. The people who are in control of the distribution of food. They maintained the food stores, they controlled the trade, they got all the money. They dressed better with beads, etc. Probably now they were getting chiefly lines of kinship. This was something observed at Spanish times also. Traditional passing down the role of chief through a family line. After 1,000 AD you see the kind of complicated villages that the Spanish discovered here. Villages that had ball courts, dance floors, separate cemeteries, sweat lodges, houses varying in size, evidence of social stratification. The appearance of monied people. Beads on a string had a fixed value. You wrapped them around your ^Nhad a few times, and that was a fixed value. This expedited exchange. This was present when the Spanish came. During this time there was a weather change. A drying out, about 1,000 AD. The smaller villages joined the larger villages where there was a reliable source of water. The small villages disappeared. In Birabent Canyon for example, there had been a seasonal camp now because of all the water from a stream, therefore a larger village springs up, almost as large as the coastal villages, and all because of the continuous supply of water. Then there was the onset of the quasi-organized provinces. Villages that were connected to each other in a special way such as inter marriages. So this famous village, ^{Soktohoamu}Soktoantu (?) over here in Birabent Canyon was the center of one of one of the major provinces that had villages from Cuyama

Valley to Sisquoc over to an area in Los Olivos and to Cachuma Lake area. This was a huge area and what was happening is that the people had intermarried with a person from Soctpamtu(?) or came from that village. A big network. And there is one interesting story about how a network could have functioned in a blood war or warfare. There was a big epidemic during Mission times over in the Cuyama Valley. The people there in the village of Shadinu(?) were convinced that the person who had started that plague through sorcery, was a fellow in one of Dos Pueblos villages. In order to get back at the man, a village in Santa Ynez was burned, because it was allied to the Dos Pueblos village. The obligation to avenge was satisfied, and they didn't need to go all the way to the coast, Santa Ynez was closer. That's how provinces may have worked even in warfare.

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